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Lover's Canyon Project

Salmon/Scott River Ranger District
Siskiyou County, California

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Introduction

This report will analyze the effects of the proposed Lover's Canyon Project to water resources (refer to chapter 2 of the Lover's Canyon Environmental Assessment (EA) for a full description of the proposed action and alternatives), in the Boulder, Canyon and Kelsey creeks tributaries to the Lower Scott River. The Forest proposes the Lover's Canyon Project to manage the landscape so that individual landscape elements and patterns are resilient to ecological processes, such as fire, occurring on the landscape scale. The intent is that a more resilient landscape will improve protection for private property and resources from high severity fire consistent with the Lower Scott River Community Wildfire Protection Plan. Although managing for more resilient landscape conditions is the ultimate purpose, the Forest will also manage for certain habitat characteristics such as those for the northern spotted owl, visual objectives, and sustainable resource outputs.

Law, Policy and Plan

The State Water Board and regional water boards implement the Federal Clean Water Act. The regional water board's Action Plan for the Scott River includes sediment and temperature Total Maximum Daily Loads (TMDL) (North Coast Water Quality Control Board (NCRWQCB) 2010a). A TMDL is the maximum amount of pollutant a water body can receive and meet water quality standards, which also achieves beneficial uses attributed to the water body.

A waiver from the State Water Board address nonpoint source pollutants from management activities associated with specific uses on National Forest System lands (NCRWQCB 2015). Potential water quality impacts are associated with erosion or reduction of stream shade.

The waiver also requires that all active and potential legacy sediment sites be identified, inventoried, prioritized, scheduled, and implemented for treatment, for all Category B projects which include: vegetation management, timber harvest; some activities conducted in designated riparian zones that pose a risk of discharge. As a condition of the waiver, Best Management Practices (BMPs) will be implemented using "on-the-ground" measures. These are in the form of Project Design Features incorporated into the alternatives (see Chapter 2 of the EA). These will also be detailed in an "implementation checklist" within the Waiver Application, which is to be submitted to the NCRWQCB after project decision.

The Klamath Forest's Land and Resource Management Plan (1995) as amended (2010), includes elements from the Northwest Forests Plan. Stated goals that are particular to this project, are to achieve water quality through Best Management Practices (BMP), and provide instream flows of sufficient quality to support riparian area and aquatic habitat.

Aquatic Conservation Strategy objectives (ASC) incorporated from the Northwest Forest Plan (USDA and USDI 1994), as it regards this project, will be discussed in more detail in Appendix A.

Analysis Indicators and Methodology

Water Resource health indicators used throughout this analysis are (related law, policy, and regulation):

- Stream Temperature/Shade (TMDL)
- Stream Sediment (TMDL)

- Changes in peak flow/base flow (LRMP, ACS Objectives)

Field Review

A field review was made of proposed treatment units with any hydrologic features and access roads, as they included legacy sediment production sites. All streams were evaluated for shade and overall health of the stream. Units that may potentially be thinned were selected for field review if current stream layers indicated that streams were within or adjacent to units, or units included or were adjacent to other landforms such as inner gorges and terrain subject to landslides because these situations may create water quality concerns. The field visits helped develop the project design features that will be implemented based on stream channel characteristics and slope breaks. In addition, the Forest Road Sediment Source Inventory (RSSI) (USDA, 2012b) was used to inventory legacy sediment sources and to assess the risk to water quality. Information was collected to allow analysis of the compliance of the project alternatives with the North Coast Regional Water Quality Control Board (Water Board) Waiver of Discharge requirements (NCRWQCB, 2015).

Office Review

An office review was conducted of: 1) existing water quality monitoring data; 2) Watershed Improvement Needs (WIN) (Legacy Sites) dataset; and 3) related scientific literature to expected project impacts.

Geographic Information System (GIS) Data Analysis

The Klamath National Forest's Cumulative Watershed Effect (CWE) models are GIS based and have three components (USDA 2004). The first is the Equivalent Roaded Area (ERA) which normalizes project impacts to a native surface road and is expressed as % ERA. For instance a clear cut acre may have a coefficient of 0.3 and a 1,000 acre watershed with 100 acres clear cut is therefore 3 % ERA. A Threshold of Concern (TOC), is a designated %ERA beyond which there is reasonable expectations for measureable or observable evidence of impacts to channel and floodplains. The TOC is calculated based on soil erodibility, hydrologic response, and slope stability.

The second CWE model, the Surface Soil Erosion (USLE) model estimates hill slope soil loss, and amount delivered to a channel estimated using the Universal Soil Loss Equation (USLE).

The third CWE model, the Geological model (GEO) compares the estimated landslide sediment production resulting from roads, harvest and fire to undisturbed condition. The driving climate parameter is a winter storm event with a 10 year return interval.

Spatial and Temporal Context for Effects Analysis

Effects are measured or estimated at the following spatial scales: (1) Site scale where effects are located in stream channels adjacent to or near treatment areas and downstream for less than 100 meters; and (2) Watershed scale where effects can be measured in the 7th field watershed.

The site scale is bound by the area proposed for treatment and the extent to which a treatment could affect channel reaches immediately downstream.

The watershed spatial scale is bound by seven watershed boundary dataset (WBD) 7th –field drainages that intersect the project area:

- Upper Canyon Creek (18010208060101)
- Lower Canyon Creek(18010208060103)
- Boulder Creek (18010208060202)
- Isinglass Creek-Scott River (18010208060203)
- North Fork Kelsey Creek (18010208060301)
- South Fork Kelsey Creek(18010208060302)
- Deep Creek-Scott River (18010208060402)

The temporal scale is defined in terms of short-term or long-term effects and varies between the analysis indicators:

Table 1. Temporal Scales used in Analysis

Analysis Indicator	Short-term effects	Long-term effects
Temperature	Effects lasting less than 10 years	Effects that persist for 10 years or more
Sediment	One year post implementation including the first winter event	Effects that persist for longer than one year post implementation
Change in Peak/Base Flow	Effects lasting less than 10 years	Effects that persist for 10 years or more

Affected Environment

Excessive sediment loads and elevated water temperatures have adversely affected the beneficial uses of the Scott River (California State Water Quality Control Board 2010). The watershed, including its tributaries, have been listed as impaired from sediment since 1992, and impaired water temperature since 1998. The Scott River TMDL Action Plan sets out the loads and directs conditions to be considered and incorporated into regulatory and non-regulatory actions in the Scott River watershed.

Stream Temperature/Shade

The Klamath River TMDL and Waivers (NCRWQCB 2010a, b, and 2015) uses stream shade as an indicator for stream temperature impairment. The Shadelator model integrates azimuth, elevation, vegetation height and position, sunrise and sunset angle, latitude, time of year, and hour angle to estimate the amount of solar radiation reaching a point of interest (USDA 2011). Thresholds for stream temperature are Maximum Weekly maximum Temperature (MWMT) which is set as a TMDL for the Scott River at 16°C. Canyon Creek, Kelsey Creek, and more recently Boulder Creek. South Fork Kelsey Creek is the primary watershed within the Lovers Canyon project, while North Fork Kelsey is not. But monitoring of Kelsey Creek is conducted at the mouth of the Scott River, and therefore is influenced by North Fork Kelsey Creek. Monitoring data showed the project area watersheds (Lower Canyon Creek and Kelsey Creek) met threshold conditions, except for Kelsey Creek, which has exceeded thresholds every year since 2011 and in 2015 had a MWMT of 19.9°C. Canyon Creek has been below thresholds every year except 2014, in which it had a MWMT of 16.6°C (USDA 2012a, USDA unpublished data 2013-2015). A caveat of monitoring is that although 85% of all Forest watersheds did not meet threshold

conditions, 15 of 20 reference watersheds (unmanaged and often issuing from high elevation and wilderness areas) also did not meet threshold conditions, indicating that the MWMT threshold of 16°C may be too low. In point of fact, the upper and greater portions of South and North Forks of the Kelsey Creek are in the Marble Mountains Wilderness. Although it should be pointed out that the temperature of Canyon Creek between 2010 and 2015 was predominantly below threshold conditions of 16°C (exceeded threshold by 0.6 degrees in 2014).

Riparian Reserves, the primary management tool for reducing management related shade reduction, follow recommendations from Standards and Guidelines from the Northwest Forest Plan (1994) table 2 below:

Table 2. Riparian Reserve widths from Forest Plan Standards and Guideline MA10-2.

Category water body	Treatment
Fish-bearing stream	From edge of active channel to distance of two site-potential trees (170 feet), 340 feet, or top of inner gorge
Perennial, non-fish bearing stream	From edge of active channel to distance of one site-potential tree (170 feet) or top of inner gorge
Wetlands greater than 1 acre	Edge of feature distance of one site-potential tree (170 feet)
Intermittent stream, wetland, 1 acre, unstable slopes	From channels distance of one site potential tree (170 feet), or outer edge of unstable slope

Stream Sedimentation

Streams within the proposed treatment area are mostly small, first order intermittent streams. Perennial flow at this scale seems associated with springs and unstable slopes, in some cases near geologic contacts of serpentine intrusions.

The GEO and USLE models incorporated into the CWE analysis relates directly to stream sedimentation. The GEO model compares the landslide sediment production as a result of existing road conditions, harvest and fire disturbances to undisturbed watershed conditions. The USLE model estimates hillslope soil delivered to a stream channel and is based upon slope, soil cover, and soil erodibility. Currently, GEO and USLE models exhibit risk ratio's less than 1 except for the Deep Creek-Scott River watershed (Table 3). This watershed is a compound watershed. Elevation of this watershed above TOC is linked to events that have occurred in the northern part of the watershed, spatially disconnected from the southern part of the watershed that is within the Lover's Canyon project, namely the Westside Fire Recover project. The Westside fire did not burn into the part of the Deep Creek-Scott River 7th field watershed that is within the Lover's Canyon project. Therefore, streams in the project area are currently at low risk of sediment contribution from hillslope erosion and landslides. GEO results have been updated to reflect 2017 winter storm events.

Table 3. Modeled cumulative watershed effects of Alternative 1

Drainage Name	Current Risk Ratio		
	USLE[1]	GEO[2]	ERA[3]
Upper Canyon Creek[4]	0.00	0.06	0.04
Lower Canyon Creek[5]	0.13	0.37	0.22
North Fork Kelsey Creek[4]	0.13	0.39	0.26
South Fork Kelsey Creek[4]	0.14	0.30	0.16
Isinglass Creek[5]	0.57	0.75	0.54
Boulder Creek[5]	0.05	0.11	0.05
Deep Creek-Scott River[4]	0.35	1.37	0.38

1- USLE risk ratios are calculated by dividing accelerated sedimentation values due to surface sediment erosion by the TOC value of 400 percent. Accelerated sedimentation is figured as "percent over background," which is calculated from 'current' model-estimated sediment delivery less background divided by background values.

2- GEO risk ratios are calculated by dividing accelerated sedimentation values due to mass-wasting by the TOC value of 200 percent. Accelerated sedimentation is figured as "percent over background," which is calculated from 'current' model-estimated sediment delivery less background divided by background values. Values have been updated to incorporate new active features as a result of the 2017 winter storm events.

3 - ERA risk ratios are calculated by dividing %ERA values by the TOC value equal to 8.0, 8.0, 8.0, 7.5, 8.0, 8.0, and 9 percent ERAs for Upper Canyon, Lower Canyon, N. Fork Kelsey, S. Fork Kelsey, Isinglass, Boulder and Deep Creeks, respectively.

4 – West Side Fire Recovery CWE 2014

5 – Forest wide CWE 2012 updated

The Klamath National Forest stream sediment monitoring program (USDA 2016a) surveyed the Lower Canyon Creek (in 2010 and 2013) and Kelsey Creek at the mouth of the Scott River (in 2011, 2014, and 2015) response reaches as part of a Forest-wide effort to meet requirements of two memoranda of understanding with the NCRWQCB (2009). Boulder Creek was not monitored. Measurements included: percent surface fines <2mm, percent subsurface fines <0.85mm and <6.35mm, and percent volume of fine sediment filling pools (V*). Most recent data for each stream was used in summary table below. All project watersheds were under the reference condition thresholds, determined from comparison with measurements of unmanaged watersheds. This indicates that erosion rates are within the range of natural conditions (table 4 below).

Table 4. Average surface, sub-surface and V* project response reaches compared to KNF reference reaches

Sediment Index	Canyon 1 reach average (%)	Kelsey reach average (%)	Reference Condition (%)
Surface Fines < 2mm	0.9	0.2	***6.4***
Sub-surface fines < 0.85mm	7.4	12.1	***16.2***
Sub-surface fines < 6.35mm	33.0	43.6	***46.1***
Fraction of pools filled with fine sediment < 2mm (V star)	0.042	0.053	***0.108***

The KNF Forest-wide RSSI (USDA 2012b), Watershed Improvement Needs Inventory and project field review identified 76 legacy sites in the Project area (Table 52 in Chapter 2 of the Lover's Canyon EA and figure 1 below). Not all of the 76 sites are within the project area as defined by the 2015 Waiver from the NCRWQCB. However, only 61 legacy sites are included in this analysis and displayed in figure 1 below. 15 legacy sites past the gate above the Boulder Trailhead on the closed portion of 44N53Y are not being analyzed through the Lover's Canyon Project NEPA, as treatment of these sites does not meet the purpose and need of the project and may pose a significant effect to other resources. These road segments may be treated through a future project.

At the time of the original KNF RSSI, 236 sites were identified in the Lover's Canyon project area. However, since that time road work has been ongoing. Both large-scale stormproofing projects, and site specific fixes have occurred, treating roughly 170 sites. Some of the 61 feasible legacy sites can be fixed with a simple ditch and culvert inlet or outlet clean-out, or armoring of existing drainage features such as rolling dips. Some sites are minor road surface rills, largely from seeps or springs on the inside shoulder area, day-lighted from road cuts, these locations also simply require dips or other simple road drainage structures. However, several of the sites require extensive work, such as replacement of an undersized culvert, and thus the removal of hundreds, even thousands of cubic years of fill from crossings. Three, non-road legacy sites were also identified (WIN1-3; in figure 1). These sites will require hydrologic stabilization of stream crossings.

Many of the landslides and resulting debris flows resulted from the 2017 winter storm events impacted streams in the area by discharging a diversity of hillslope sediment and large woody debris into stream channels. This sediment and woody debris from landslide activity is a natural occurrence, it is a necessary source of material to stimulate fluvial geomorphic processes that create high water quality and aquatic organism habitat. However, landslides that spawned from human-created infrastructure such as roads cause in stream sediment transport to be out of balance. Only two of the landslides and debris flows from the 2017 winter storm events were clearly caused from the road system. One of the sites started from a 44N45 fill failure at mile post 2.43. The debris flow moved down to Canyon Creek and discharged significant sediment and debris. It is unknown how much sediment was mobilized but approximately 100 cubic yards were discharged to Canyon Creek and have altered the channel dimensions at the point of entry. The other started from a 44N24B fill failure at mile post 0.27, which traveled across 44N41. Approximately 14,000 cubic yards of debris were mobilized, however it was not fully discharged to Scott River. Human caused and natural landslides and debris flows have been reported to the Regional Water Board via discharge notifications.

While legacy sites often stimulate landslides and debris flows (in the worst cases), the landslides and resulting debris flows themselves (once caused) are not legacy sites. They are often not human caused, not reasonable and feasible to fix, and landslide debris sometimes does not reach any surface watercourse. However, often times these mass wasting events cause existing legacy sites to change. Heavy precipitation (and or melt runoff) events cause new legacy sites to become evident. Before the 2017 winter storm events there were 74 legacy sites within the Lovers Canyon Project boundary which altogether totaled 13,080 cubic yards of at risk sediment (though only 61 are being analyzed for treatment). These sites are undersized culverts, culverts with diversion potential, and minor road surface drainage dysfunctions. The 2017 winter storm events created two additional legacy sites with a combined at risk sediment volume of approximately 80 cubic yards (Sites: 43N19 – 0.78 and 44N45 – 4.18, see Table 61 in Appendix C of the EA). The storm events also changed the condition of five existing sites. Three existing undersized culverts blew out and diverted flow and two culverts were buried under landslide debris. The current status of these five sites is that they remain legacy sites, but have an imminent risk of failure. One of the five sites (44N45 – 2.74, see Table 61 in Appendix C of the EA) is a significantly blown culvert that removed 10 feet of road surface making it impassible by large vehicles, this site will be fixed through Forest road maintenance.

Please see Appendix B in the EA for locations of new active features and geological details of 2017 winter storms. Also, full descriptions and locations of project area legacy sites are available in Appendix C of the EA.

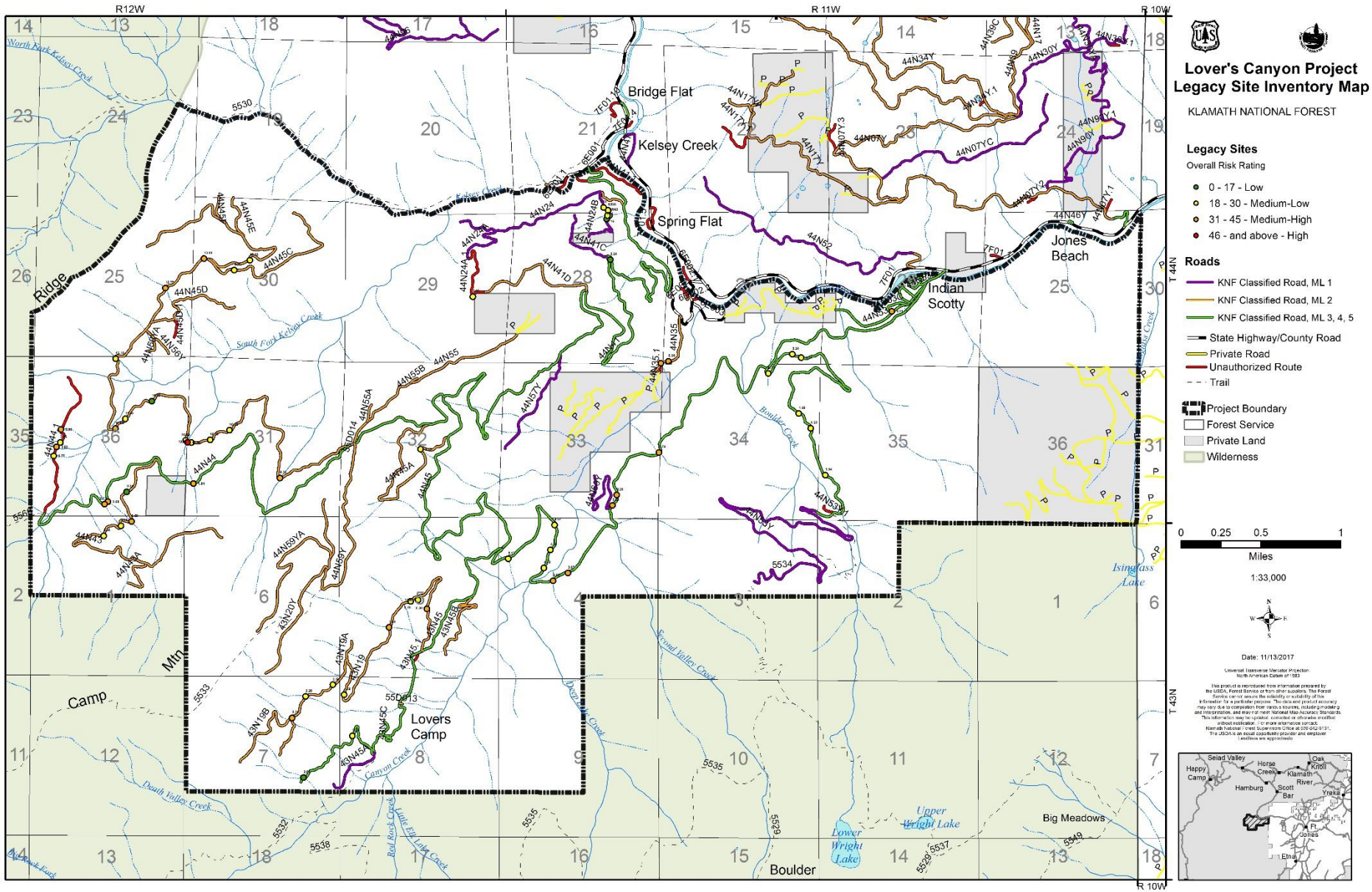

Figure 1: Project Area Legacy Sites

Changes in Peak flow/base flow

No stream gauging stations have been installed on the analysis area drainages to provide direct measurements of peak and base flow. As with other drainages in the region that have recorded stream flows, the project area streams are expected to quickly respond to rainfall events resulting in steeply rising and falling hydrographs with prolonged low flow recession limbs. Historically, rain on snow events typically result in the largest peak flow, floods and debris flow events (De La Fuente and Elder 1998). While stream gauges would be the most direct method for measuring differences in peak and base flows, the ERA method of the Klamath CWE modeling process provides an accurate estimate of canopy reduction and thus of primary project effects to hydrology. Table 5 below shows that the current condition of % ERA is well below thresholds in all project watersheds. All watersheds are currently below the TOC for ERA, therefore, there are currently no management related changes in peak flow/base flow in streams within the analysis area.

Table 5. Relative percent ERA by watershed => Cumulative Effects Watershed Model Outputs Baseline

Drainage Name	Drainage (acres)	% ERA	TOC (%)
Upper Canyon Creek	5179	0.33	8.0
Lower Canyon Creek	6535	1.78	8.0
North Fork Kelsey Creek	5177	2.08	8.0
South Fork Kelsey Creek	6199	1.18	7.5
Isinglass Creek	5950	4.33	8.0
Boulder Creek	2693	3.97	8.0
Deep Creek-Scott River	3798	3.4	9.0

1 – Includes roads, wildfire and vegetation management actions within all management areas of a given drainage

2 – Includes roads, wildfire and vegetation actions in stream course Riparian Reserves alone

Desired Condition

Table 6 below outlines how the analysis area is currently meeting desired conditions relating to the analysis indicators for water resources. Stream temperature (MWMT) is not met in the Kelsey Creek watershed.

Table 6. Comparison of desired versus existing condition for water quality indicators

Indicator	Measure	Existing Condition	Desired Condition	Are desired conditions being met?
Stream sedimentation	1. Surface fines 2. Subsurface sediment 3. Subsurface sediment 4. Pools filled with sediment (Vstar)	1. 0.9 - 4.2 2. 7.4 – 12.9 3. 33 – 41.6 4. 0.04 - 0.07	1. 6.4 2. 16.2 3. 46.1 4. 0.108	1. Yes 2. Yes 3. Yes 4. Yes
	Soil erosion	Risk Ratio: 0.00 to 0.16	< 1.0	Yes
	Mass-wasting risk	Risk Ratio: 0.06 to 0.43	Risk Ratio < 1.0	Yes
	ERA by Drainage	0.33 to 4.33 % ERA	< 7.5 to 9.0 % ERA	Yes
	Road Density	0.66 to 1.48 km/km^2	Less than 2.0 km/square km	Yes
	Legacy Sites	73 Legacy Sites	0 Legacy sites	No

Stream Temp.	Max Weekly Max Temperature	12.1-19.9°C	16°C	**No***
Stream Shade	% Shade Average for Watershed	83.9-89.3	69.7	Yes
Peak flow and base flow	Equivalent Roaded Area (ERA)	0.64 to 5.1 % ERA	< 6.5 to 9.0 % ERA (or TOC)	Yes

**--Depends on measurement year's air temperatures and runoff. Kelsey Creek MWMT was 17.2°C in 2010, 15.8°C in 2011, and 19.9 in 2015.*

Environmental Effects

For a complete description of the alternatives considered in detail refer to chapter 2 of the Lover's Canyon EA.

Alternative 1 – No Action

Direct and Indirect Effects

The desired conditions are currently being met for all analysis indicators except for the temperature in Kelsey, however, in the long-term negative effects may become evident under the No Action Alternative.

Stream Temperature

In terms of temperature and riparian vegetation health, it would be expected that conditions would remain the same or improve due to increasing stream side canopy, with the exception of the stands listed in Appendix B which are mostly plantations. Stands that have riparian treatment proposed are expected to deteriorate over time due to pine beetle and increased densities leading to mortality. However, because these stands are predominantly located in upslope areas, disconnected from perennial stream flow, there will still be no or very little negative effect to stream temperature in the long term. There will likely be no long term negative effect to stream temperature (shade) under the no action alternative, unless a stand replacing, high-severity wildfire occurs.

Fuels analysis shows that there is an increase in the risk of stand replacing wildfire in the No Action Alternative (Fuels Report). In the event of a large stand replacing wildfire, there would likely be indirect negative effects to the temperature of streams in the project area due to reduction of shade in Riparian Reserves. If a large stand replacing fire occurred, the magnitude of temperature change could be similar to the change observed in the Grider and Walker drainages following the 2014 Westside fire. Magnitude of the change in temperature has yet to be determined as data is still being organized from the 2015 and 2016 temperature field seasons. Be that as it may, in the event of a stand replacing wild fire there will still likely be indirect negative effect to the temperature of the streams in the project area in the short term.

Stream Sediment

Under the No Action Alternative, the project will not occur and there will be no project-related ground disturbance. Therefore, the GEO/USLE models are not expected to change and will remain as described under the Affected Environment (Table 3).

However, under the No Action alternative, 61 Legacy Sites identified in the project area will not be treated. In the event of a 100+ year occurrence interval storm, many of the inventoried legacy sites will likely blow out causing up to 9,194 yd^3 sediment delivered to streams in the project

area. Debris flows and landslides triggered by these fill failures could cause long term changes to stream sediment regimes. During the 1997 event, an estimate recurrence interval of only 14-37 years, debris flows initiated by landslides had their highest densities in roaded corridors because of unstable fill prisms and stream crossing failures. These flows scoured channel reaches, removed riparian vegetation, and deposited sediment and large logs in lower reaches (De La Fuente and Elder, 1998). Similar results could be expected as a result of the No Action alternative as a result of not treating 61 existing legacy sites.

Changes in Peak Flow/Base Flow

There are not expected to be short term negative or positive effects to peak flow/base flow in the project area resulting from the no action alternative as no canopy cover will be removed. ERA is currently below the threshold of concern for all 7th field watersheds (table 5).

Cumulative Effects

There will be no cumulative effects to water resources as a result of the no action alternative. Currently, there is no physical overlap or temporal overlap of effects with other past, on-going, and future foreseeable actions.

Cumulative effects only occur when the effect of one project overlaps with or compounds the effects of another. The Lover's Canyon Project does not influence the implementation of any nearby project, no visa-versa.

Potential projects that overlap with this project area: Lake Mountain-Middle Tompkins Allotment Management Plan, Westside Fire Recovery, Scot Mountain Underburn and Habitat Improvement, and Woolley Water/Road Special Use Permit Renewal. Of these projects, only the boundary of Westside Fire Recovery overlaps with that of Lover's Canyon Project, but does not include physical overlap of units, road use, or drafting sites. The other three projects share 7th field watersheds with the Lover's Canyon Project, but are otherwise spatially distinct in regards to implementation footprint.

Alternative 2 and 3 – Proposed Action

Differences in the effects of Alternatives 2 and 3 are nonconsequential to water resources. Unit boundaries have the same footprints. Changes were a wildlife concern, incorporating more harvest unit skips.

Direct and Indirect Effects

Stream Temperature

Riparian Reserve management zones are the primary mechanism for protection of site potential shade to perennial and intermittent streams. Riparian Reserves in this project have been closely analyzed and site specific, unit specific recommendations have been made for each Riparian Reserve where it overlaps with a treatment unit.

Overall, there are two classes of riparian reserves in the Lover's Canyon project: Riparian Reserves within plantations in upland areas, and Riparian Reserves in Natural Stands in both upland and perennial areas. Recommendations and protection vary significantly between these two Riparian Reserve types. Riparian Reserves with plantations will be treated in order to achieve ACS objectives (See Appendix B, Riparian Reserve Treatments), by enhancing stand health and long term shade provision or helping to create robust stands that can resist stand-replacing

wildfire. Most of these Riparian Reserves have a 50' equipment exclusion zone and 15' no-treatment buffer. In these areas, there is expected to be a short term reduction in shade at the site scale, but no measurable resulting increase in temperature at the watershed scale as most plantations occur in upland locations with intermittent streams that do not flow during summer months. A long term increase in shade at the site scale can be expected as plantations respond to thinning, but similarly, no measurable decrease to temperature can be expected to be observed at the watershed scale. Riparian Reserve widths within natural stands are given in Appendix B (And Table 1), and are much greater than those within plantations. Entry zones were restricted to first major break in slope and beyond (outside of inner gorge). The RR widths will be effective in creating a low probability of sedimentation into the stream channel, as well as preserve steam shading, maintaining water temperatures to potential for all surface water. The proposed action will remove no shade in natural stand Riparian Reserves, therefore, there will be no effect to stream temperature.

There are also unstable lands Riparian Reserves that have been delineated around all existing and new (from the 2017 winter storm events) active landslide features. Project activities will not affect these features, therefore, no detrimental effect to streams and watercourses in the project area will occur.

Stream Sediment

All project activities, including temporary road on existing roadbed, hydrologic stabilization and legacy site mitigation, will increase the likelihood of sediment delivery at the site scale to stream channels in the short term. In the long-term, the mitigation of 61 legacy sites and the hydrologic stabilization of temporary roads will reduce potential sediment delivery by over 9,194 yd^3.

Sediment produced from timber harvest and thinning activities will have short term effects at the site scale. Material sand size or greater will deposit in a few meters or less, and then progressively longer distances are required for finer particles. Even at 30 meters, clay sized particles will not be entirely winnowed out and account for most of the material still entrained. Sediment will deposit in a strip at the beginning of a buffer until the cover is effectively buried. Then the sediment deposition area advances a few meters. Since nutrient elements are mostly bound to sediment the first 10 meters is also the most effective for trapping nutrients. Periodic review of research on the effect of streamside buffers has found consistent results in terms of maintaining water quality (Castelle et al. 1994, Fischer and Fischenich 2000). Forest floors present a relatively high resistance to shallow surface flow. Buffers of any vegetative type, of about 90 feet will remove 80-90 percent of nutrient and sediment load, largely through resistance and dispersal of the transporting sheet wash.

The Cumulative Watershed Effects model results incorporate the GEO and USLE models (table 7) inclusive of project activities do not show movement towards TOCs, and therefore, no measurable increase in sediment loading to streams from project activities in the long-term. There will be no increase in sediment production from new active features in the 2017 winter storm events because these features have been identified and project activities have been adjusted to avoid them.

Table 7. Modeled cumulative watershed effects of Alternative 2 and 3 (with the increase in Risk Ratio from project activities within the parenthesis)

Drainage Name	Cumulative Risk Ratio (increase in Risk Ratio)		
	USLE	GEO_2	ERA_3
Upper Canyon Creek	0.00 (0)	0.06 (0)	0.04 (0)
Lower Canyon Creek	0.16 (0.03)	0.44 (0.07)	0.43 (0.21)
North Fork Kelsey Creek	0.13 (0)	0.39 (0)	0.26 (0)
South Fork Kelsey Creek	0.15 (0.01)	0.31 (0.01)	0.19 (0.03)
Isinglass Creek	0.58 (0.01)	0.75 (0)	0.56 (0.02)
Boulder Creek	0.05 (0)	0.11 (0)	0.06 (0.01)
Deep Creek-Scott River	0.37 (0.02)	1.40 (0.03)	0.44 (0.06)

1- USLE risk ratios are calculated by dividing accelerated sedimentation values due to surface sediment erosion by the TOC value of 400 percent. Accelerated sedimentation is figured as "percent over background," which is calculated from 'current' model-estimated sediment delivery less background divided by background values.
2- GEO risk ratios are calculated by dividing accelerated sedimentation values due to mass-wasting by the TOC value of 200 percent. Accelerated sedimentation is figured as "percent over background," which is calculated from 'current' model-estimated sediment delivery less background divided by background values.
3 - ERA risk ratios are calculated by dividing %ERA values by the TOC value equal to 8.0, 8.0, 8.0, 7.5, 8.0, 8.0, and 9 percent ERAs for Upper Canyon, Lower Canyon, N. Fork Kelsey, S. Fork Kelsey, Isinglass, Boulder and Deep Creeks, respectively.
4 – West Side Fire Recovery CWE 2014
5 – Forest wide CWE 2012 updated

Changes to Peak Flow/Base Flow

Alternative 2 and 3 ERA results (table 7 above) show that additional canopy reduction and ground disturbance, which is accounted for in the model, does not move the total ERA to more than 0.5% of the total watershed area. The greatest reduction is for Isinglass Creek watershed with 0.56 of 8.0% TOC or 4.48% of the total area, well below thresholds research has found for measureable impacts (Bosh and Hewlett 1982, Stednick 1996, Brown et al. 2005, Grant et al 2008). Therefore, there will be no long term effects to stream peak flow/base flow as a result of project activities. Precise short term effects to peak flow/base flow are mostly unknown, but are expected to be minimal if present.

Cumulative Effects

The Deep Creek-Scott River 7th field watershed is over the Threshold of Concern because of the 2014 Happy Camp Complex fire which took space in a spatially distinct segment of this compound watershed. Effect from the Lover's Canyon Project will not cumulatively add to the effects of the Happy Camp Complex because they are spatially separate. The grazing activities in the Lake Mountain and Middle Tompkins Allotments are also spatially disconnected from the Lover's Canyon Project within this same watershed. All other watersheds are well below the Threshold of Concern. The sediment regime and flow regime will not affect beneficial uses.

The effects from the Westside Fire Recovery Project and the Scott Bar Mountain Underburn and Habitat Improvement Project were accounted for in the modeling and are part of the affected environment.

Grazing is an ongoing action that is occurring within the 7th field analysis area. Grazing allotment boundaries do overlap spatially with the Lover's Canyon Project area however, within proposed units there has been no grazing impacts observed, therefore, impacts from grazing are not occurring at the same reach scale as from the Lover's Canyon Project. The impacts to stream

shade/temperature and sediment from grazing will not be measurable or significant at the 7th field watershed scale.

Allotments within the Lover's Canyon project 7th field analysis areas have been monitored in 2009 (USDA 2009) and 2016 (USDA 2016b). BMP evaluations both years were found to be meeting forest plan standards and guidelines, and effectiveness criteria was demonstrating that water quality standard s were being protected.

Summary of Analysis and Discussion of Compliance with Forest Plan and Other Relevant Laws, Regulations, Policies and Plans

Analysis Indicators and Methodology

The effects of the Lover's Canyon Project were analyzed through field visits, geographic information system reports, and modeling. All streams were evaluated for shade and overall health. Units that may potentially be thinned were selected for field review if current stream layers indicated that streams were within or adjacent to units or other landforms such as inner gorges and terrain subject to landslides as these situations may create water quality concerns. The field visits were used to develop the project design features that would be implemented based on stream channel characteristics. In addition, the Klamath National Forest Road Sediment Source Inventory (USDA 2012a) was used to inventory legacy sediment sources and to assess the risk to water quality. Information was collected to allow analysis of the compliance of the project alternatives with the North Coast Regional Water Quality Control Board Waiver of Discharge requirements (NCRWQCB 2015).

Cumulative Watershed Effects models are used to evaluate the risk associated with action alternatives. Three models are used. The Equivalent Roaded Area (ERA) model is used to estimate changes in peak flow and base flow by ground-disturbing activities in action alternatives. The Geological (GEO) cumulative watershed effects model compares the landslide sediment production of action alternatives to the production if the watershed was undisturbed. The Universal Soil Loss Equation (USLE) model estimates sediment delivered to a stream channel. The modeled risks are based on the effects of actions or events and do not take into account the project design features that minimize negative effects to sediment delivery, landslide potential, or peak flows. The threshold of concern for the risk ratios for all three cumulative watershed effects models is 1.0. A risk ratio greater than or equal to 1.0 is a yellow flag and calls for a closer look at mitigation opportunities. **Cumulative Watershed Effects: the Abridged Version (USDA Forest Service 2012b) provides a more detailed description of the model.**

Analysis Indicators

- Stream Temperature/Shade: estimated by stream shade and canopy cover.
- Stream Sedimentation: estimated by Legacy Sites, and the Geologic and Universal Soil Loss Equation models.
- Changes in peak flow/base flow: estimated by the Equivalent Roaded Area model.

Impacts to beneficial uses for watersheds and riparian areas within the project area would be determined using these analysis indicators.

Spatial and Temporal Bounding of the Analysis Area

Effects of alternatives are measured or estimated at the site and watershed spatial scales. At the site scale, effects are located in stream channels adjacent to or near treatment areas and

downstream for less than 100 meters. Watershed scale effects can be measured in the response reach of a 7th field watershed.

The temporal scale may be either short or long term in duration. Short term effects are evident in one year (for the sediment analysis indicator), or up to 10 years (for temperature and changes in peak flow/base flow analysis indicators), after project implementation. Long term effects are those that persist for more than 10 years.

Affected Environment

As a tributary to the Klamath River, the Lower Scott River is listed in the 303(d) Clean Water Act for stream temperature and sediment impairment as discussed in the Water Quality Resource Report. As a result, the Klamath River Total Maximum Daily Load was developed to reduce and prevent excess sediment inputs that influence stream temperature and maintain and restore site potential stream shade in an effort to decrease water temperatures. To help implement these goals, waiver discharge requirements for non-point sources on federal lands (waiver) were developed that include treatment of legacy sediment sources and maintenance or improvement of stream shade (NCRWQCB, 2015). A stream sediment and temperature monitoring program is required to document existing conditions, develop reference conditions, and track recovery of water bodies. Stream monitoring for sediment and temperature on a Forest-wide sample of "managed" and "reference" streams is displayed in annual monitoring reports as noted in the Water Quality Resource Report for Lover's Canyon.

The most recent monitoring results show both South Fork Kelsey Creek (18010208060302) and Lower Canyon (18010208060103) Creeks, which are "managed" streams within Lovers Canyon project, are below reference conditions for all sediment indices. Canyon and Kelsey Creeks were also included in Forest-wide temperature monitoring (while Boulder Creek is not) and have consistent data between 2011 and 2015. Canyon Creek was below the threshold of 16 degrees Celsius every year (except in 2014, 16.6 degrees Celsius), but Kelsey Creek was above the threshold every year, with a Maximum Weekly Maximum Temperature of 19.9°C in 2015. Therefore, beneficial uses are currently not being affected in Canyon Creek; while it is possible that beneficial uses in Kelsey Creek may be impaired.

All watersheds within the project area are currently modeled as below the threshold of concern for cumulative watershed effects (including the Equivalent Roaded Area, Geologic, and Universal Soil Loss Equation models) except one 7th field watershed (Deep Creek-Scott River) for the Geologic model, shown in Table below. This watershed is a compound watershed and the portion of this watershed above threshold of concern is linked to events that have occurred in the northern part of the watershed, namely the 2014 Happy Camp Complex. This portion of the watershed is spatially disconnected from the southern part of the watershed that is within the Lover's Canyon Project area.

Legacy sediment sources or sites are considered as those with existing sediment discharge or potential discharge areas or sites that are the result of human activity from the past and can reasonably and feasibly be remedied (NCRWQCB, 2015). Direct discharge of sediment to streams during storms has negative effects on water quality that need to be addressed to be in compliance with the Clean Water Act. Proposed activities to address this include treating legacy sediment sites to minimize sediment delivery to streams.

A total of 76 legacy sites were identified, however 15 sites are not being analyzed for treatment as part of this project proposal. Therefore, 61 sites are being analyzed for treatment within the

project area. These sites sum a total of 9,194 cubic yards of potential sediment that could be delivered to watercourses within the project area. Appendix C provides descriptions and relative risk ratings of the 61 legacy sites in the Lover's Canyon Project area.

The winter of 2017 resulted in storm damage throughout the project area. Heavy precipitation caused multiple new active landslide features to develop, these features affected both roads and proposed treatment units within the project area. The GEO model results have been updated to reflect the 2017 winter storm events. Many of the landslides and resulting debris flows impacted streams in the area by discharging a variety of hillslope sediment and large woody debris into stream channels. This sediment and woody debris from landslide activity is a natural occurrence, it is a necessary source of material to stimulate fluvial geomorphic processes that create high water quality and aquatic organism habitat. However, landslides that spawned from human-created infrastructure, such as roads, cause in stream sediment transport to be out of balance. Only two of the landslides and debris flows from the 2017 winter storm events were clearly caused from the road system. One of the sites started from a 44N45 fill failure at mile post 2.43. The debris flow moved down to Canyon Creek and discharged significant sediment and debris. It is unknown how much sediment was mobilized but about 100 cubic yards were discharged to Canyon Creek and have altered the channel dimensions at the point of entry. The other started from a 44N24B fill failure at mile post 0.27, which traveled across 44N41. About 14,000 cubic yards of debris were mobilized, however, it was not fully discharged to Scott River. Human caused and natural landslides and debris flows have been reported to the Regional Water Board via discharge notifications (see appendix B for further details regarding the 2017 storm events).

The 2017 Deep Fire burned about 30 acres within the water quality analysis area, however, the low severity of this fire did not change the baseline condition of the analysis indicators for water quality.

Table 8. Modeled background conditions (risk ratios) by watershed with risk ratios over Threshold of Concern in bold.

Drainage Name	Current Risk Ratio $USLE_1$	Current Risk Ratio GEO_2	Current Risk Ratio ERA_3
Upper Canyon Creek	0.00	0.06	0.04
Lower Canyon Creek	0.13	0.37	0.22
North Fork Kelsey Creek	0.13	0.39	0.26
South Fork Kelsey Creek	0.14	0.30	0.16
Isinglass Creek	0.57	0.75	0.54
Boulder Creek	0.05	0.11	0.05
Deep Creek-Scott River	0.35	**1.37**	0.38

1. USLE risk ratios are calculated by dividing accelerated sedimentation values due to surface sediment erosion by an inference point value of 400 percent. Accelerated sedimentation is figured as "percent over background", which is calculated from 'current' model-estimated sediment delivery less background divided by background values.
2. GEO risk ratios are calculated by dividing accelerated sedimentation values due to mass-wasting by an inference point value of 200 percent. Accelerated sedimentation is figured as "percent over background", which is calculated form 'current' model-estimated sediment delivery less background divided by background values. Values have been updated to incorporate new active features as a result of the 2017 winter storm events.
3. ERA risk ratios are calculated by dividing ERA values by an inference point value equal to the threshold of concern.

Environmental Consequences

Alternative 1

Direct and Indirect Effects

Alternative 1 would not actively move existing conditions toward desired conditions. Most of the fill material contained in legacy sites would still be available to be delivered to tributaries of the Lower Scott River during a large storm event. This may result in adverse effects to water quality. Without treatment in this alternative, the 61 legacy sites in the project area would continue to produce sediment and increase the risk of landslides. If a catastrophic flood event occurred, about 9,194 cubic yards of sediment could be contributed to project area perennial streams as a result of the failure of these 61 road related legacy sites. Alternative 1 would not result in any short or long term improvements to watershed condition. Although modeled risk ratios would slowly recover, stream sediment measured in response reaches is expected to remain the same or increase as untreated legacy sites continue to chronically or catastrophically fail over time. Under alternative 1, fuels would continue to accumulate within the project area, this would lead to an increased risk of stand replacing wildfire. If a stand replacing wildfire occurred within the project area there would be measurable negative effects to stream temperatures due to potential vegetation and canopy (shade) loss. Under alternative 1, short term negative or positive effects to peak flow/base flow are not expected in the project area.

Cumulative Effects

Past action, including timber harvest and thinning, are evident on the landscape in the project area and are included in the discussion of the affected environment. Adding the effects of this alternative to the effects of ongoing and reasonably foreseeable future actions would not produce substantial cumulative effects to the indicators of stream temperature, shade, or peak/base flow. None of the risk ratios would change measurably as displayed in the Water Quality Resource Report. The effects to water quality of not treating 61 legacy sites would not have a cumulative effect because there are no other ongoing or future actions that would treat legacy sites in this project area.

Effects Common to Alternatives 2 and 3

For water quality, the effects of alternatives 2 and 3 have no measurable difference and will be discussed together. Alternative 3 includes more skip areas in a set of units than alternative 2, this difference would not have a measurable difference in effects to analysis indicators at the site or watershed scale.

Direct and Indirect Effects

Stream Temperature and Shade: The proposed action would not remove shade from riparian reserves in natural stands, therefore it would have no negative effect to stream temperature in those areas. Watershed specialists measured shade within riparian reserves and determined the appropriate treatment and equipment exclusion zones to maintain site potential shade in all natural stands. The proposed treatments include thinning a larger area of the riparian reserves within plantations. This may cause a short term reduction in shade, but no measurable resulting increase in stream temperature at the watershed scale because these riparian reserves are almost entirely intermittent streams. A long term increase in shade at the site scale can be expected as plantations respond to thinning and the trees grow larger, but similarly, no measurable decrease to stream temperature can be expected at the watershed scale. There are also unstable lands Riparian Reserves that have been delineated around all existing and new active landslide features. Project

activities are limited in these areas, therefore, no detrimental effect to streams and watercourses in the project area would occur.

Stream Sedimentation: The actions proposed in alternatives 2 and 3, including the use of temporary roads on existing roadbeds, hydrologic stabilization, vegetation treatment, and legacy site mitigation, would increase the likelihood of sediment delivery at the site scale to stream channels in the short term. Additionally, there would be a minimal short term increase in sediment delivery to stream channels from the hillslope soil movement (USLE) and landslide potential (GEO). The effects to the sediment regime in the long term, would not be discernible. The mitigation of legacy sites and the hydrologic stabilization of temporary roads on existing road beds would reduce the potential sediment delivery by up to 9,194 yd^3 of sediment in the long term. New active landslide features would be buffered from commercial logging harvest and equipment activities, there would be no increase in sediment production to streams from this proposal in relation to active landslide features.

Change in Peak/Base Flow: The effects of the proposed treatments to the Equivalent Roaded Area model, which accounts for canopy reduction and ground disturbance, does not move the total Equivalent Roaded Area to more than 0.5 percent of the total watershed area. The only 7th field watershed with a noteworthy increase in Equivalent Roaded Area is Isinglass Creek watershed. There is a .02 risk ratio increase from this project that is well below the threshold of concern. Precise short term effects to peak flow/base flow are unknown, but are expected to be minimal because of the small increase in Equivalent Roaded Area risk ratio (if present).

Table below shows the risk ratios by watershed as modeled under the treatments proposed in alternatives 2 and 3. There is no measurable difference between these alternatives as modeled because the models cannot account for the subtle differences of a change in prescription. Table also displays the difference in the risk ratios between the no action alternative and alternatives 2 and 3. The models show that this project area is still under the threshold of concern with the additional risk from the Lover's Canyon Project, except for Deep Creek-Scott River which exceeds the threshold of concern before project effects are considered due to the Happy Camp Fires of 2014.

Table 9. Modeled risk ratios by watershed for alternatives 2 and 3 (numbers in parentheses indicate the increase in risk ratio from the no action alternative)

Drainage Name	Cumulative Risk Ratio (increase in Risk Ratio)		
	USLE	GEO	ERA
Upper Canyon Creek	0.00 (0)	0.06 (0)	0.04 (0)
Lower Canyon Creek	0.16 (0.03)	0.44 (0.07)	0.43 (0.21)
North Fork Kelsey Creek	0.13 (0)	0.39 (0)	0.26 (0)
South Fork Kelsey Creek	0.15 (0.01)	0.31 (0.01)	0.19 (0.03)
Isinglass Creek	0.58 (0.01)	0.75 (0)	0.56 (0.02)
Boulder Creek	0.05 (0)	0.11 (0)	0.06 (0.01)
Deep Creek-Scott River	0.37 (0.02)	1.40 (0.03)	0.44 (0.06)
*The USLE, GEO, and ERA risk ratios are calculated as described in Table above.			

Cumulative Effects

The Deep Creek-Scott River 7th field watershed is over the threshold of concern because of the 2014 Happy Camp Complex fire which took place in a spatially distinct segment of this compound watershed. Effects from the Lover's Canyon Project would not cumulatively add to the effects of the Happy Camp Complex because they are spatially separate. All other watersheds are well below the threshold of concern. The sediment regime and flow regime would not affect beneficial uses.

The effects from the Westside Fire Recovery Project and the Scott Bar Mountain Underburn and Habitat Improvement Project were accounted for in the modeling and are part of the affected environment.

Grazing is an ongoing action that is occurring within the 7th field analysis area. Grazing allotment boundaries do overlap the Lover's Canyon Project area, however, within proposed units there have been no grazing impacts observed. Therefore, impacts from grazing are not occurring at the same reach scale as from the Lover's Canyon Project. The impacts to stream shade/temperature and sediment from grazing added to the effects described from the Lover's Canyon Project would not be measurable or significant at the 7th field watershed scale. Allotments within the Lover's Canyon Project 7th field analysis areas have been monitored in 2009 (USDA 2009) and 2016 (Silviculture Specialist Report). Best Management Practices evaluations both years were found to be meeting Forest Plan standards and guidelines, and effectiveness criteria demonstrated that water quality standards were being protected.

Comparison of Effects

Table below displays a comparison of the effects to the water quality analysis indicators between alternatives.

Table 10. Comparison of Effects to Water Quality Analysis Indicators

Indicator	Alternative 1	Alternatives 2 or 3
Stream Temperature and Shade	No direct or indirect effects to stream temperature or shade in the absence of a stand replacing wildfire.	No negative effect to stream temperature in natural stands. Thinning in riparian reserves within plantations may cause a short term reduction in shade, but no measurable increase in stream temperature at the watershed scale. A long term increase in shade expected as plantations respond to thinning.
Stream Sedimentation	The 61 legacy sites would not be treated under this alternative and would continue to produce sediment and increase the risk of landslides.	Minimal short term increase in sediment delivery to stream channels, not discernible in the long term. The mitigation of legacy sites and the hydrologic stabilization of temporary roads on existing roadbeds would reduce the potential sediment delivery by up to 9,194 cubic yards of sediment in the long term. An increase in the Risk Ratio of Lower Canyon Creek for GEO was observed as a result of the project, however, this would not cause a high risk of sedimentation because the Risk Ratio is still well below the threshold of concern.
Change in Peak/Base Flow	No effects are expected to peak flow/base flow.	Precise short term effects to peak flow/base flow are unknown, but are expected to be minimal because of the small increase in Equivalent Roaded Area risk ratio.

Compliance with Law, Policy, Regulation, and the Forest Plan

The conditions in the Waiver of Discharge Requirements for Nonpoint Source Discharges Related to Certain Federal Land Management Activities on National Forest System Lands in the North Coast Region (NCRWQCB 2015) would be met for the project with completion of the waiver application after the Decision Notice for the Lover's Canyon Project is signed. Meeting waiver requirements equals compliance with the Clean Water Act. Forest plan standards are met by consistency with the Aquatic Conservation Strategy, as displayed in appendix F and the Forest Plan Consistency Checklist, available on the project website.

References

Bosch, J.M., and J.D. Hewlett, 1982. A review of catchment experiments to determine the effect of vegetation changes on water yield and evapotranspiration. Journal of Hydrology (55) 3-23.

Brown, A.E., L. Zhang, T.A. McMahon, A.W. Western, and R.A. Vertessy. 2005. A review of paired catchment studies for determining changes in water yield resulting from alterations in vegetation. Journal of Hydrology. 310: 28-61

Castelle, A.J., A.W. Johnson, and C. Conolly. 1994. Wetland and stream buffer size requirements—A review. Journal of Environmental Quality 23:878-882

De La Fuente, J. and D. Elder. 1998. The flood of 1997 Klamath National Forest Phase I Final Report: November 24, 1998. Yreka, CA.

Fischer, R.A., and J.C. Fischenich, 2000. Design recommendations for riparian corridors and vegetated buffer strips. U.S. Army Engineer Research and Design Center. ERDC-TN-EMRRP-SR-24.

Grant, G.E., S.L. Lewis, F.J. Swanson, J.H. Cissel, and J.J. McDonnell. 2008. Effects of forest practices on peakflows and consequent channel response: a state-of-science report for western Oregon and Washington. USDA, Forest Service, Pacific Northwest Research Station, GTR-760. Reston, VA.

North Coast Regional Water Quality Control Board. 2009. Scott River Memorandum of Understanding between the California Regional Water Quality Control Board North Coast Region and U.S. Forest Service Klamath National Forest Pacific Southwest Region.

North Coast Regional Water Quality Control Board (NCRWQCB). 2010a. Klamath River TMDL – Allocations and Numeric Targets, Chapter 5 In: Final staff report for the Klamath River total maximum daily loads (TMDLs) addressing temperature, dissolved oxygen, nutrient, and microcystin impairments in California.

North Coast Regional Water Quality Control Board (NCRWQCB). 2010b. Order No. R1-2010-0029, Waiver of Waste Discharge Requirements for Nonpoint Source Discharges on Federal Lands. Santo Rosa, CA.

North Coast Regional Water Quality Control Board (NCRWQCB). 2015. Order No. R1-2015-0021, Waiver of Waste Discharge Requirements for Nonpoint Source Discharges on Federal Lands. Santo Rosa, CA.

Stednick, J.D. 1996. Monitoring the effects of timber harvest on annual water yield. Journal of Hydrology. 176: 79-95.

USDA. 1994. Canyon Ecosystem Analysis: Klamath National Forest, Yreka, CA. October 21, 1994.

USDA. 1995a (updated through 2010). Land and Resource Management Plan for the Klamath National Forest. Yreka, CA.

USDA. 1995b. Record of decision for the final environmental impact statement of the Klamath National Forest, Forest Plan. Yreka, CA.

USDA. 2000. Klamath National Forest Lower Scott Ecosystem Analysis. Yreka, CA. U.S. Department of Agriculture, Forest Service, Klamath National Forest.

USDA. 2004. Cumulative Watershed Effects Analysis, Klamath National Forest; Quantitative Models for Surface Erosion, Mass-Wasting and ERA/TOC. Klamath National Forest. Yreka, CA.

USDA 2009. 2009 Best Management Practices Report. Yreka, CA.

USDA. 2011. Stream shade monitoring on the Klamath National Forest, 2010. Yreka, C

USDA. 2012a. Stream temperature monitoring on the Klamath National Forest: 2010 – 2011. Yreka, CA.

USDA. 2012b. Klamath National Forest Forest-wide Road Inventory. Road Sediment Source Inventory and Risk Assessment. Yreka, CA.

USDA. 2016a. Streambed sediment conditions on the Klamath National Forest 2009 – 2015. Yreka, CA.

USDA. 2016b. Unpublished report, "Big Rock National BMP." Fort Jones, CA.

USDA and USDI. 1994. *Record of Decision for the Final Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest Related Species within the Range of the Northern Spotted Owl.* Standards and guidelines for management of habitat for late-successional and old-growth forest related species within the range of the northern spotted owl. Portland, OR.

Appendix A

Aquatic Conservation Strategy (ACS)

The Forest Plan contains the components, objectives and standards and guidelines for consistency of projects with the Aquatic Conservation Strategy (ACS). The Record of Decision of the Forest Plan (USDA Forest Service 1995c) is the guiding document for Forest projects; the Forest Record of Decision incorporates the Aquatic Conservation Strategy Standards and Guidelines from the Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents with the Range of the Northern Spotted Owl (commonly known as the Northwest Forest Plan) (USDA Forest Service and USDI Bureau of Land Management 1994). The Forest Plan lists four components of the Aquatic Conservation Strategy, as stated on pages 4-25 through 4-27 of the Forest Plan: "1) Riparian Reserves, 2) Key Watersheds, 3) Watershed Analysis and 4) Watershed Restoration" (USDA Forest Service 1995a). The Lover's Canyon Project addresses these components as follows:

Riparian Reserves: Some proposed activities in the Lover's Canyon Project will occur in Riparian Reserves. Although the purpose of the Lover's Canyon Project is not to restore watersheds, treatment prescriptions for units within Riparian Reserves are developed with input from wildlife and fish specialists and earth scientists to insure that Best Management Practices from the Pacific Southwest Region Water Quality Management for Forested Lands in California: Best Management Practices and Water Quality Management Handbook are followed. Project-specific Best Management Practices and project design features are developed to reduce negative effects of the project and meet the requirement of the Forest Plan (p. 4-106) to prohibit and regulate activities in riparian reserves that can retard or prevent attainment of the Aquatic Conservation Strategy Objectives.

Key Watersheds: The Lover's Canyon Project is not in a Key Watershed.

Watershed Analysis: A watershed analysis was completed for the Lover's Canyon area. It is entitled *Klamath National Forest Lower Scott Watershed Assessment* (USDA Forest Service, 2000). Additionally, the *Canyon Watershed Analysis* (1994) was also referenced for watershed information. Information from both sources was used when locating and designing proposed activities for the project. Recommendations from the watershed analysis related to the purpose and need of this project were considered in developing treatments, prescriptions and project design features.

Watershed Restoration: Watershed restoration, including fish passage improvement, removing and upgrading roads, and restoration of large trees in riparian reserves, is an ongoing program on the Forest but not part of the purpose and need for the Lover's Canyon Project. However, proposed treatments in the project contribute to watershed restoration. These treatments include:

- Thinning small trees in the plantations that currently exist in riparian reserves to encourage the growth of larger trees by reducing competition from small trees.
- Using prescribed burns to reduce fuel loading, thereby decreasing the potential for excessive watershed degradation that can occur from a high intensity wildfire.
- Repairing legacy sediment sources via removing diversion potentials, installing rolling dips, reducing fills, upgrading culverts to pass 100-year floods, and re-establishing a diverted channel.

- Hydrologically restoring temporary roads that will be used during project implementation.

Alternatives for the project are evaluated to determine the effects to riparian reserves at the site, reach, 7th field, and 5th field watershed scales in the short and long term to determine effects on water quality, and on anadromous fish and their habitat. Both stream-course riparian reserves and those on unstable and potentially unstable areas (unstable-land riparian reserves) are included in the analysis and evaluation. The conclusions of these evaluations for each alternative are summarized by Aquatic Conservation Strategy Objectives, as follows:

Aquatic Conservation Strategy Objectives for the Lover's Canyon Project
Aquatic Conservation Strategy Objectives are presented without a distinction between alternative 2 and alternative 3. The difference between these two alternatives in regards to Aquatic Conservation Strategy is insufficiently significant to require separate discussion. Specialist reports used to construct this document include Aquatics, Botany, Fuels, Hydrology, Vegetation, and Soils. The discussion concerning Aquatic Conservation Strategy Objectives must begin with a background understanding of the natural range of variability found on the landscape.

Aquatic Conservation Strategy Objective 1: Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted.

Watershed complexity in this project is primarily a consideration of effects to large wood recruitment, the distribution of large trees in riparian reserves, and the drainage network.

Natural Range of Variability: Little quantitative data is available regarding the historic range of variability of large woody debris (in-channel wood) and large trees in the riparian reserves. Assumptions can be made considering the history of disturbance. The sources of large woody debris have been reduced from historical conditions by commercial timber harvest, altered fire regime, and flood scour. In the past, frequent wildfires would have contributed to well-distributed instream wood by creating snags that eventually fall, thereby recruiting to creeks. Stumps in the project area suggest that large trees were once well distributed throughout the project area. The drainage network has been modified by mining and roads. Mining ditches that were cut into the hillslope were abandoned once the large scale mining ceased by the 1930s and do not currently divert water.

*Determination – **Maintain/Restore-*** Either action alternative will maintain/restore distribution, diversity, and complexity of watershed and landscape-scale features for aquatic systems within the project area.

The project is anticipated to provide long term (decadal) benefit in an improved trend for large woody debris recruitment to instream channels and stream shading in the riparian reserves. The treatment in both the commercial and non-commercial units is modeled to increase quadratic mean diameter (similar to the average tree diameter) of the stands by about 3 inches over the next 30 years (explained in more detail in the Vegetation section of chapter 3). The expected increase post treatment is due to the treatment of overstocked stands and the decrease of bark beetle occurrence under the current condition. In the short term, there may be a slight decrease at the site-level in regards to smaller size classes of in-channel wood (i.e. branches, small trees) within plantations where treatments could occur less than one tree-length from stream channels. However, this change will not affect larger systems downslope, including the fish-bearing waters. Long term benefits to riparian reserves will be most apparent within upslope plantation units

because the larger treatment exclusion zones associated with natural stands and any unit associated with fish-occupied waters will limit silvicultural activities within riparian reserves. Project design features targeted towards silvicultural and fuels treatments will maintain the current level of instream wood during implementation. There will be no long term negative change to peak flows or debris flow potential as a result of the project. Conversely, it is expected that legacy sediment site treatments will actually reduce the occurrence of road-related debris flows. The potential transport of woody debris to Boulder Creek, Canyon Creek, Kelsey Creek, and Scott River will be maintained.

Legacy sediment site repairs will impart some restoration towards more natural drainage conditions by addressing the diversion potential at road crossings and cross-drain locations, thereby locally reducing impacts to the drainage network which has occurred due to capture of small ephemeral and intermittent streams by roadbeds.

Conditions at the 5th field watershed will not be significantly changed but will move towards desired conditions as large wood migrates downstream over time. Also, decreased fuel loading within project area streams will help mitigate possible large scale fires that could affect the entire 5th field watershed.

Aquatic Conservation Strategy Objective 2: Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic- and riparian-dependent species.

Watershed connectivity takes into consideration the effect to aquatic species, fish, and riparian dependent terrestrial species passage in the project area and within the larger 5th field watershed.

Natural Range of Variability: Roads which have been constructed upon the landscape for timber and minerals extraction, and are currently in use for recreational purposes, disrupt watershed network connections and can affect the life histories of aquatic- and riparian-dependent species. Undersized or poorly placed culverts are the primary component disrupting connectivity. For example, within the project area, there are two culvert crossings of South Fork Kelsey Creek considered to be fish barriers. Additionally, there are many smaller culverts associated with non-fish-bearing streams which may affect free movement of aquatic-oriented amphibians and invertebrates; and even those species able to navigate terrestrial environs are potentially subject to greater exposure to vehicle-related mortality by being forced to leave a stream drainage to cross a road.

*Determination – **Maintain/Restore*** – Either action alternative will maintain/restore spatial and temporal connectivity within and between watersheds for aquatic- and riparian-dependent species.

Treatment of legacy sediment sites has the potential to benefit watershed connectivity. Although the two South Fork Kelsey crossing were decided to be beyond the scope of the project, there were numerous legacy sediment site culvert issues identified which are associated with small, non-fish-bearing systems. These headwater systems may be perennial or seasonal in nature, but they do contribute towards the overall connectivity that amphibians, aquatic/riparian invertebrates, and small mammals require for their normal life histories. Where culverts are upgraded, there may be a local benefit for those species which utilize the stream corridor. Other

proposed project activities, including silviculture and prescribed fire treatments, will not affect the current level of connectivity experienced by aquatic and riparian oriented species. Water drafting as a connected action will not alter the watershed connectivity function of stream corridors. Effects to fish and other aquatic wildlife will be localized, insignificant, and short term.

Though not designed solely as an aquatic organism passage project, the removal and upgrading of culverts for the treatment of legacy sediment sites will provide a small benefit to maintain and restore the movement of local populations of aquatic organisms. This will help to maintain and restore populations at the 5th field watershed scale by providing opportunities for the larger population to access additional habitat.

Aquatic Conservation Strategy Objective 3: Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.

Aquatic systems integrity considers effects to channel geomorphology and direct impact to bank and stream bottom.

Natural Range of Variability: Streambanks, shorelines, and stream bottoms in the project area are naturally varied and heterogeneous. A downed tree or small landslide may impact bank, shore, and bottom configuration; and debris flows can affect features along miles of stream channel. Recent stream surveys indicate streambanks tend to be stable and stream channels exhibit complex in-channel habitats and varied substrates.

*Determination –**Maintain/Restore*- Either action alternative will maintain/restore the physical integrity of the aquatic system, including streambanks, shorelines, and channel bottoms.

No direct, permanent disturbance to stream channels will occur due to most proposed actions. The project includes project design features which prohibit steam-side and in-channel activities which would permanently alter stream channel character. For instance, trees directly rooted into banks cannot be cut; and where minor channel modifications (i.e. damming) to non-fish-bearing streams are allowed to enhance water drafting, these alterations must be returned to pre-project conditions once use is complete. There will be no landscape change in channel geomorphology because road density will not increase.

The project will not prevent the attainment of the physical integrity of the aquatic system at the 5th field watershed scale.

Aquatic Conservation Strategy Objective 4: Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction and migration of individuals composing aquatic and riparian communities.

The Scott River in the project area is listed as impaired by the California State Clean Water Act 303(d) list for stream temperature and sediment. Tributaries, unless specified otherwise, are included in the listing of their primary "mainstem" system. Due to the Forest monitoring program, upper Canyon Creek (a reference drainage in the Marble Mountain Wilderness) was removed from the State 303(d) list in 2014. Water quality analysis will primarily focus on temperature (with stream shade as a proxy, where applicable). Stream sediment is addressed in Objective 5 and, therefore, is excluded from the discussion of this objective.

Natural Range of Variability:

Historically, project area stream temperature would have varied depending on recent disturbances, particularly debris flows and patches of fire-killed vegetation. But in general, the average stream temperature would have likely been cooler than it is today. Legacy mining, logging, and other management related effects have caused project area streams to exhibit elevated water temperatures.

Stream shade was assessed for project units within riparian reserves. Natural stands are meeting natural potential shade. Shading in plantations was found to average 14% less than natural stands, and thereby not meeting shade objectives. Where shade is not meeting desired conditions, there is the potential for stream temperature to be elevated above the expected normal.

Within the project area, recent stream temperature data (starting 2010) is available for Boulder Creek, Canyon Creek, Kelsey Creek, and Scott River. Stream temperature monitoring has determined both Canyon Creek and Boulder Creek meet the state maximum weekly water temperature threshold of 16^0C to support beneficial uses for core juvenile salmonid rearing; and Kelsey Creek exceeds the threshold some years. Scott River exhibits elevated summer water temperatures that exceed threshold every year.

Determination – ***Maintain/Restore-*** In the short term either action alternative may insignificantly increase stream temperature for the site (local) scale. In the long term, water quality will return to the current baseline and/or may exhibit an insignificant benefit.

Potential effects of project activities upon shade is anticipated to be limited to plantation units. Natural stands and units located adjacent to fish-bearing streams include large buffers and canopy retention guidelines for treatments in the riparian reserves to ensure effective shade levels will be retained. Alternatively, trees in plantations could be removed as close as 15 feet from stream channels, which has the potential to further decrease shade in riparian reserves in the short term where conditions are not presently met.

In the short term, there is the potential that stream temperature may be negatively affected on the site scale within and immediately below plantations. Impact will be limited to units which include perennial and/or late-season flowing streams. Summer is the critical period for elevated water temperature; and, as such, those channels which are dry during the summer months cannot be impacted. At the larger 7^{th} field and 5^{th} field watershed scale – specifically, the fish-bearing streams which are the focus of state temperature beneficial uses – no meaningful negative effect is anticipated because the input from these potentially affected streams is minimal when compared to the volume of the mainstem Scott River. The project will not prevent attainment of water quality objectives in the Scott River.

In the long term, shade in plantations is expected to increase to a level more comparable to natural stands due to a more robust and diverse stand composition.

Prescribed fire treatments are not expected to affect effective shade along stream channels. Project design features and burn prescriptions will limit fire effects within riparian reserves. If there is no or minimal change to overstory vegetation character (i.e. shade), then there cannot be a detrimental impact to water temperature.

<u>Aquatic Conservation Strategy Objective 5:</u> Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.

The Scott River in the project area is listed as impaired by the California State Clean Water Act 303(d) list for sediment. Tributaries, unless specified otherwise, are included in the listing of their primary "mainstem" system. Due to the Forest monitoring program, the upper Canyon Creek (a reference drainage) was removed from the State 303(d) list for sediment in 2014. Sediment regime will primarily focus on sediment inputs quantified through Cumulative Watershed Effects modeling, in stream sediment monitoring data, and legacy sediment site condition.

Natural Range of Variability: Sediment supply and routing in the Klamath Mountains is dominated by episodic disturbance events. Generally, decadal wet winters have stimulated frequent mast wasting events which supply and transport large quantities of diverse sediments to water courses. During dryer years, water courses would be in different stages of geomorphic adjustment as disturbance supplied sediment continued to slowly move down stream and riparian vegetation responded and recovered from the disturbance. However, the majority of streams would have been in dynamic equilibrium, a state of balance between hydrologic inputs (sediment and flow) and a channel's ability to transport those inputs. Therefore, the majority of streams would have been in a stable condition.

Cumulative Watershed Effects modeling shows a background landslide potential between 6,607 and 19,415 (with a mean of 11,062) cubic yards per decade of sediment delivered to streams under pre-disturbance conditions for the project area 7th field watersheds (Refer to the Geology Resource Report). Background hillslope sediment delivered to streams varied between 60 and 153 cubic yards per year for project area 7th field watersheds, according to the USLE model.

The total current modeled GEO risk ratio ranges from 0.06 to 1.37 within project area 7th field watersheds. Current landslide volume is more than background because of road system contribution, past timber harvest, and the 2014 wildfires. The total current landslide volumes including background is between 8,115 and 31,041 (with a mean of 19,496) cubic yards of sediment per decade. The total current USLE risk ration ranges from 0.00 to 0.57 within project area 7th field watersheds.

Though the ERA model does not produce outputs in measurable sediment volumes, it provides a general indicator of human caused sediment producing disturbances within watersheds. The total current ERA ranges between 10 and 257 acres within project area 7th field watersheds. This is well below thresholds of concern in all cases. Within the project area, streambed sediment data is available for Canyon Creek and Kelsey Creek. The most recent set of comprehensive surveys (between 2009 and 2015) detailed pool volume (V*) and surface/subsurface sediment composition, finding all four key indicators under consideration to be meeting reference conditions. Sediment variables are subject to fluctuation on an annual basis.

A total of 74 legacy sites were discovered within the project area. These sites are capable of causing the discharge of 13,606 yd^3 of road-related sediments to project area streams through chronic erosion of road surfaces, stream diversion, and stream crossing fill failure.

Determination – ***Maintain/Restore –*** Either action alternative will maintain/restore the local sediment regime in regards to timing, volume, rate, and character of sediment input, storage, and transport on both the local, 7th field, and 5th field watershed scales. While there may be a short term increase of sediment input, long term effects of the project will be beneficial.

In the short term, there may be minor negative effects to sediment movement related to ground disturbing actions such as timber harvest, fuels reduction, and actions within stream channels such as legacy sediment site repair and water drafting. These actions could mobilize small

quantities of fine sediment at the site-scale. This will be undetectable at the reach scale, 300 feet downstream from the originating source.

The Cumulative Watershed Effects models were run to simulate the effects of project activities on sediment input these models do not account for the positive effect of BMPs and legacy sediment site treatments. Therefore the models show increased sediment input as a result of this project in some 7th field watersheds. There will be no significant effects to beneficial uses from any project activities at either the 7th or 5th field watershed scale as the project is not causing a significant increase to risk ratios. Neither is the project causing any watershed that is currently under its Threshold of Concern to exceed its Threshold of Concern. Model estimates for ERA, USLE, and GEO models remain below the critical threshold for all drainages except for the Deep Creek-Scott River 7th field watershed, and that only for the GEO model. This watershed was over threshold (at a risk ratio of 1.37) due to pre-project legacy affects, of which the primary cause is the road system. There is a slight increase from the current state due to project activities, moving the risk ratio from 1.37 to 1.40, however this does not account for proposed legacy sediment site treatments.

Model results were summarized at the 5th field scale (the entire Lower Scott River watershed) as well as the 7th field scale. The Lower Scott River does show elevated sediment projection, but the results are well below thresholds of concern for all models.

Legacy site treatments were not modeled with other project activities because the treatment plan had not yet been finalized at the time of the model run. Had these treatments been included, it would have been demonstrated that the project as a whole was providing a net benefit to sediment production by reducing risk ratios; a result seen repeatedly in other project modeling data across the Forest. This is due to the fact that USFS road systems are the single largest contributor to human-elevated sediment production for all processes: mass wasting (GEO), surface erosion (USLE), and general disturbance (ERA). Legacy Site treatments directly eliminate or greatly reduce the risk of road related sediment input to streams. 74 legacy sites were found throughout the project area on system and non-system roads. All but 13 sites are being proposed for treatment through the project. This will maintain and restore the sediment regime at the site, 7th, and 5th field watershed scales.

Finally, despite the fact that there are legacy site in the project area and that human-caused legacy affects persist that have elevated CWE model results, the latest in-stream sediment monitoring data shows all project area streams (7th field scale) to be in compliance, meeting reference condition. This further supports the conclusion that the effects of the project will ultimately be a benefit to sediment regime of the Scott River and its tributaries.

<u>Aquatic Conservation Strategy Objective 6</u>: Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats, and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high and low flows must be protected.

Water quantity discussion considers the effect to base flow using a qualitative assessment and peak flow using the Equivalent Roaded Area Model.

Natural Range of Variability: The historical range of variability for base and peak flow for streams in the project area falls from 100-year flood events like the flood of 1964 to drought years where the snow pack is less than 10% of normal. On an annual basis, spring-fed perennial streams have less variation in their base flows than snow-melt driven intermittent streams. Large

fires can increase peak flows because of reduction of plants which uptake water, and decrease in precipitation interception and roughness that slow the water on the hillslope. There are no noteworthy diversions in the project area.

Of note, surface and ground water is diverted during irrigation season in the Scott Valley. This has a downstream impact to the mainstem Scott River, including adjacent to the project area, by decreasing flows. These artificially decreased summer/fall base flows are identified as an issue of concern in regards to health of the aquatic ecosystem and its fauna.

Determination – ***Will not prevent attainment*** – Either action alternative will not affect in-stream flows in the project area; and attainment of the objective will not be prevented in either the short- or long term.

There will be no 7th or 5th field watershed-scale changes to peak/base flows from either action alternative due to the upslope position, localized impacts, and functioning buffering capacity of intervening riparian reserve habitat. This is reflected in the equivalent roaded area model output, which remains well below the threshold of concern for all modeled watersheds at both scales.

At the site-scale, in-stream flows would only be affected by water drafting. Project design features and Best Management Practices applicable to all drafting sites ensure the pumping rate will not exceed 350 gallons per minute (or 10% of the flow of any anadromous stream) and pumping is done in short periods. Water drafting will result in only slight temporary decreases in flow, which will be undetectable a short distance downstream. Because base and peak flows will not be measurably affected at the project scale, there will be no effect at the 7th and 5th field watershed scale.

<u>Aquatic Conservation Strategy Objective 7:</u> Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.

Flow regime considers effects to the potential inundation of floodplain in the project area.

Natural Range of Variability: Floodplain inundation is a natural process that recharges groundwater. High flows also naturally increase watershed complexity by modifying stream banks and gravel bars. Portions of the floodplain are inundated every year or two, with flood years filling the floodplain with slow moving water the entire width of the inner canyon. Mining along the lower Scott River, including the project area, has modified the floodplain by removing river terraces and leaving behind steep headcut banks and tailing piles.

Determination – ***Will not prevent attainment* –** Either action alternative will not affect inundation of floodplains in the project area.

7th field project area tributaries of the lower Scott River that contribute to floodplain inundation will remain unchanged in the short and long term. Therefore similarly, the lower Scott River (5th field watershed) will also remain unchanged. Either action alternative will have no effect on floodplain inundation and will therefore not prevent the attainment of this objective.

<u>Aquatic Conservation Strategy Objective 8:</u> Maintain and restore the species composition and structural diversity of the plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, and appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.

Species composition and structural diversity considers the expected response of conifer and hardwood trees in the riparian reserves. Discussion will include coarse woody debris on the hillslopes. Sediment regime, bank stability, and instream wood elements have previously been discussed (see objectives 1, 3, and 5).

Natural Range of Variability: The composition of vegetation is influenced by elevation. Upper elevations (above 5,000 feet) are typically dominated by white fir. Conversely, stands blend into the mixed conifer timber type at the lower elevations. Aspect also strongly influences stand composition, Douglas-fir and white fir dominate north and east facing slopes, while pine, incense cedar, and Douglas-fir dominate south and west facing slopes. Within the project area, with the exception of plantations, there has not been significant departure from historic species composition. Structurally, there has been a departure from historic conditions as a result of extensive timber harvesting between the 1950s and 1990s; the vast majority of overstory has been removed, and the landscape is largely lacking in pole and medium/large conifer stands, which have been replaced by a smaller conifer class (See the Silviculture Resource Report).

Little quantitative data is available regarding the historic range of variability of coarse woody debris (i.e. terrestrial downed wood). The sources of large coarse wood have been reduced from historical conditions by commercial harvest and altered fire regime. In the past, frequent wildfires would have contributed to well-distributed coarse woody debris by creating snags that eventually fall, thereby recruiting to the hillsides and other terrestrial environments.

Determination – ***Maintain/Restore*** – Either action alternative will maintain/restore species composition and structural diversity of plant communities in riparian reserves.

At the site scale, silvicultural treatments will move conifer stands (natural and plantations) toward greater structural diversity and less homogeneous species composition. However, treatments will not affect the current species composition because there will be no tree planting nor conversion of monoculture plantations to reflect historical species diversity.

The project is anticipated to provide long term (decadal) benefits in an improved trend for terrestrial coarse wood at the site and 7th field watershed scale. The treatment in both the commercial and non-commercial units is modeled to increase the quadratic mean diameter (See the Silviculture Resource Report). Therefore, larger trees will eventually be available for recruitment. Benefits to riparian reserves will be most apparent within upslope plantation units because the larger treatment exclusion zones associated with natural stands and any unit associated with fish-occupied waters will limit silvicultural activities within riparian reserves. Project design features targeted towards silvicultural and fuels treatments will maintain the current levels of coarse woody debris during implementation.

Prescribed fire treatments are not expected to affect plant composition or structural diversity along stream channels. Project design features and burn prescriptions will limit fire effects within riparian reserves. While there may be some tree mortality, it is expected to be minimal due to anticipated low fire severity; and while recruitment of dead wood to the forest floor may slightly increase in the short term, the long term scenario will be similar to the current condition.

5th field scale coarse woody debris recruitment will not be affected by the project, therefore the project will not prevent the attainment of the objective.

<u>Aquatic Conservation Strategy Objective 9:</u> Maintain and restore well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.

Discussion considers the effect of the project upon the quantity and quality of riparian reserve habitat for riparian-dependent animal and plant species, including the risk of spread of noxious weeds.

Natural Range of Variability: Historically, near-stream vegetation was likely a mix of conifer, willow, and alder in streams; and the edges of the riparian zone gradated to the large conifers representative of old-growth forest. Site and reach level character could experience modification and be reset to an earlier seral state as a result of flood scour and debris flows. Logging and mining activities, as well as changes to the fire regime, have altered the riparian reserve condition; and non-native noxious weed species have been introduced in places. The subsequent effect to native plants and animals within the project area is unknown, but current distribution is likely similar to historical distribution (See objective 2 for discussion about watershed connectivity).

Determination – ***Will not prevent attainment –*** Either action alternative will maintain the quantity and quality of habitat for riparian-dependent and aquatic animal and plant species in the short and long term at the local and 7th and 5th field watershed scales.

Treatments within riparian reserves are expected to move the riparian community towards a more historic composition, allowing riparian-dependent flora and fauna to maintain current distribution within the project area and 7th and 5th field watersheds. Benefits to riparian reserves will be most apparent within upslope plantation units because the larger treatment exclusion zones associated with natural stands and any unit associated with fish-occupied waters will limit silvicultural activities within riparian reserves. Due to lack of historical data, it is not possible to compare current and past distributions of riparian dependent/aquatic animal and plant species. However, it is unlikely that there has been a measurable change in the project area given the natural population fluctuations appropriate to each species. Because there has likely not been a sufficient alteration from historical conditions to stream or near-stream terrestrial habitat to measurably affect distribution of local riparian-dependent species, the post-project goal to move conifer stands towards desired conditions for stand structure is similarly expected to have minimal or no effect.

Both action alternatives pose a low risk of weed introduction or spread due to project design features. In turn, native species which are sensitive to competition by weeds will not be affected.

The treatment of legacy sediment sites in regards to drainage connectivity was discussed under objective 2. In summary, the repair of legacy sediment sites which may restrict movement of riparian-oriented fauna will maintain the local distribution of potentially impacted individuals/species.

Appendix B: Riparian Reserve Treatments

Table 8. All Alternative 2 and 3 units within designated Riparian Reserves with current shade and buffers for protecting shade and ACS objectives.

Unit #	Treatment Type	RR Size[1]	Equip Exclusion Dist (ft)	No Treatment Buffer Dist (ft)	Plantation Unit	Current Shade (%), Notes	Other Notes
Unit 524-054	Skyline	7.2	170' - Boulder Ck 50' - spring	Same as equip. exclusion distance		80% Treatment has no effect to shade.	Upon field review, closest flagged edge of unit to creek was ~150'; and nearest marked trees was ~40' upslope from boundary. Therefore, treatment was confirmed to be outside of 170'.
Unit 524-055	Skyline	14.5	170' - Boulder Ck	Same as equip. exclusion distance		85% Treatment has no effect to shade.	Upon field review, closest flagged edge of unit to creek was ~140-150'; and several marked trees were at ~150'. Less than 10 trees were observed closer than 170' from the creek in area of nearest boundary approach to water. Although these trees are within the no treatment buffer (equipment will still be outside), harvest will be allowed - shade will be maintained, other trees will remain, and it is only one location with a minimal number of trees under consideration.
Unit 526-008	Tractor	1.9	50' - all streams	15' - all streams	X	85% Short term loss of shade, long term increase.	
Unit 526-010a	Tractor	1.7	170' - Canyon Creek 100' - perennial	Same as equip. exclusion distance	X	95% No effect to shade.	Additionally, exclusion zones are set 25' back from the break in slope to Second Valley Ck.

Unit #	Treatment Type	RR Size[1]	Equip Exclusion Dist (ft)	No Treatment Buffer Dist (ft)	Plantation Unit	Current Shade (%), Notes	Other Notes
Unit 526-013	Tractor	1.1	50' - all streams	Same as equip. exclusion distance		85% Very slight short term effect to shade but long term increase	Legacy site (Map ID: WIN3) located within the unit will be treated.
Unit 526-019	Tractor	1.5	50' - all streams (above road) 100' - all streams (below road)	15' - all streams	X	98% Short term loss of shade, long term increase	
Unit 526-020	Tractor	6.0	50' - all streams	15' - all streams	X	99%, Short term loss of shade, long term increase	
Unit 526-030	Tractor	9.2	50' - all streams	15' - all streams	X	90% Short term loss of shade, long term increase	
Unit 526-031a	Tractor	7.3	50' - all streams	15' - all streams	X	85% Short term loss of shade, long term increase	
Unit 526-031b	Tractor	0.2	50' - all streams	15' - all streams	X	85% Short term loss of shade, long term increase	
Unit 526-064	Skyline	9.1	50' - all streams	Same as equip. exclusion distance		97% No effect to long term shade.	

Unit #	Treatment Type	RR Size[1]	Equip Exclusion Dist (ft)	No Treatment Buffer Dist (ft)	Plantation Unit	Current Shade (%), Notes	Other Notes
Unit 526-073	Tractor	6.1	50' - all streams 50' - spring	Same as equip. exclusion distance		85% No effect to shade	Intermittent channel mis-mapped: it does not bisect the unit, but instead follows the southern edge
Unit 526-076	Tractor	4.1	50' - all streams	Same as equip. exclusion distance		90% No effect to shade	Additionally, exclusion zones are set 25' back from the break in slope to the creek.
Unit 526-080	Tractor	0.3	50' - pond	Same as equip. exclusion distance		N/A, water subsurface. No effect to waterbody temp.	
Unit 526-085	Skyline	6.2	50' - all streams	Same as equip. exclusion distance		99% No effect to shade.	
Unit 526-086	Skyline	9.6	50' - all streams	Same as equip. exclusion distance		99% No effect to shade.	
Unit 526-089	Tractor	7.9	50' - all streams	Same as equip. exclusion distance		99% No effect to shade.	No treatment between two intermittent channels.
Unit 526-097	Skyline	2.0	None - see notes	Same as equip. exclusion distance		98% No effect to shade, no surface water present.	Intermittent channel mapped as originating from meadow is not present. Without a stream, there is no RR; and, furthermore, no associated equip/treatment avoidance area is needed.

Unit #	Treatment Type	RR Size[1]	Equip Exclusion Dist (ft)	No Treatment Buffer Dist (ft)	Plantation Unit	Current Shade (%), Notes	Other Notes
Unit 526-098a	Tractor	15.2	50' - all streams	Same as equip. exclusion distance		98% No effect to shade, buffer is beyond break in slope.	More aggressive tree removal adjacent to meadow to enhance meadow character. Intermittent channel mapped as originating from meadow is not present. Without a stream, there is no RR; and, furthermore, no associated equip/treatment avoidance area is needed.
Unit 526-103	Skyline	0.3	50' - all streams	Same as equip. exclusion distance		90%, no effect to shade. Unit barely in RR.	
Unit 526-104	Tractor	0.8	50' - all streams	Same as equip. exclusion distance		90%, no effect to shade. Unit barely in RR.	
Unit 526-109	Skyline	12.5	50' - all streams	Same as equip. exclusion distance		95%, no long term effect to shade.	
Unit 526-110	Skyline	5.0	Road - Canyon Ck None - intermittent (see notes)	Same as equip. exclusion distance		N/A	Major access road separates stream from unit. RR within unit is not functioning as riparian due to topographic configuration and disconnect by road. Intermittent channel mapped as originating from meadow is not present. Without a stream, there is no RR; and, furthermore, no associated equip/treatment avoidance area is needed.
Unit 526-111	Skyline	3.0	170' - Canyon Creek	Same as equip. exclusion distance		Unknown Shade. But no effect with 170' equip excl. buffer.	

Unit #	Treatment Type	RR Size[1]	Equip Exclusion Dist (ft)	No Treatment Buffer Dist (ft)	Plantation Unit	Current Shade (%), Notes	Other Notes
Unit 526-146	Tractor	1.4	170' - Canyon Creek 100' - perennial	Same as equip. exclusion distance		95%, no effect to shade.	
Unit 526-197	Endline	1.3	50' - all streams	Same as equip. exclusion distance		95%, no effect to shade.	
Unit 527-012	Tractor	5.8	50' - all streams (above road) 100' - all streams (below road)	15' - all streams	X	85%, short term loss but long term increase of shade.	Road serving as dividing line is 44N45D.
Unit 527-029	Tractor	0.3	None - see notes	None - see notes	X	N/A	RR mapped in unit is the outer edge of the extreme headwaters of an intermittent. Riparian vegetation not present in unit; and remainder of headwater area buffered by a PCT unit.
Unit 527-081	Tractor	0.7	50' - all streams	Same as equip. exclusion distance		90%, no effect on shade.	
Unit 527-082	Tractor	0.1	100' - all streams	Same as equip. exclusion distance		N/A, No streams in unit.	
Unit 526-098b	Skyline	7.3	50' - all streams (above	Same as equip.		98%, no effect to shade	

Unit #	Treatment Type	RR Size[1]	Equip Exclusion Dist (ft)	No Treatment Buffer Dist (ft)	Plantation Unit	Current Shade (%), Notes	Other Notes
			road) 100' - all streams (below road)	exclusion distance			
Unit 527-150	Skyline	1.3	100' - all streams	Same as equip. exclusion distance		Unknown Shade. But likely no effect with 100' equip excl buffer.	
Mastication	PCT	21.5	170' - fish-bearing streams 100' - fishless streams - no culvert between activity and fish-bearing stream 50' - fishless streams - above roads	None - see analysis	X	Likely not to effect shade. If effect, only short term.	Masticators may reach with arm into equip. exclusion zone to masticate trees. Trees out of reach of arm will be hand-cut. Hand-cut material may be piled/burned, else transported to masticator for disposal. 13 of 34 units include RR within the unit boundary.
Total		172.4					

[1]Hydrologic Riparian Reserves (RR) widths estimated by GIS buffering are calculated as if the terrain was flat. Because RR widths are measured as slope distances, GIS areas overestimate the acreage within RR when local terrain includes extensive gorges. In some locations, Project units may therefore be outside the RR. Furthermore, several units have mismapped stream channels - channels are not present, and, therefore, nor is the mapped RR. In summary, many units include much less RR than suggested by this table.